

"METHOD FOR SEALING CAPSULES AND APPARATUS TO PERFORM SAID METHOD"

DESCRIPTION

5 The present invention relates to a procedure and an apparatus for sealing capsules formed of a body and a cap inserted axially and partially one inside the other, for example cylindrical capsules of solid gelatin containing pharmaceuticals to be administered orally together with the capsule.

10 A method and a relative device to perform it are known, wherein the capsules are deposited in respective seats produced and distributed regularly in slats of a conveyor belt. This conveyor is designed to carry the capsules to an element that distributes a sealing solution along the rim of the cap of the capsule, and then to maintain the capsules in a ventilated environment for the time required for the seal to dry and consolidate. A method of this type is for example utilized by apparatus called "Hicapseal 40" and "Hicapseal 100" marketed by "Schaefer
15 Technologies Inc., 4251 N.Shadeland Av.-Indianapolis (IN) 46226 USA. An important drawback of these apparatus is the large number of slats with seats for the capsules required to guarantee drying and consolidation of the seal prior to unloading the sealed capsules. With this arrangement, each time the form and/or dimension of the capsules to be sealed changes, all the slats must be replaced, with
20 a laborious operation that immobilizes the apparatus for a considerable time.

The object of the present invention is to essentially reduce said drawback.

The invention comprises a method to place the capsules to be sealed in respective seats of a first rigid support movable in steps, the support being designed to feed the capsules to means that distribute a suitably heated sealing
25 solution along the rim of the cap of each capsule, to transport the capsules thereby wetted for a certain number of steps to a transfer station in a second rigid support movable in steps provided with a plurality of seats each designed to contain a respective capsule, the number of seats of said second support being much larger, possibly multiple, than those of the seats of the first support. The second movable

support then in turn transports the capsules for a certain number of steps to an unloading station of the sealed capsules. The dwell time of each support between one step and the next and the number of steps required to transfer a wetted capsule to the unloading station are such that the overall time between distribution of the sealing solution on the capsule and its unloading are sufficient to consolidate sealing.

The seats of the supports are shaped to contain the capsules with minimum clearance.

The change in format of the capsules to be sealed therefore causes replacement of the two rigid supports, a simple and rapid operation, with an advantage with respect to the aforesaid prior art.

In a preferred embodiment of the invention, according to the method the capsules are disposed in the first rigid support according to a horizontal position and in the second rigid support in a vertical position. In this way, as the overall length of the capsules is generally much greater than the width, a much larger number of capsules can be disposed on the second support, although the dimension of said support can remain limited, for example with overall dimensions essentially similar to those of the first support.

Preferably, the capsules in the second support are disposed with the cap facing downwards, to allow unloading of the capsules from the sealing apparatus through gravity.

The invention also relates to an apparatus to perform the method hereinbefore, which apparatus is provided with means to feed capsules positioned for sealing, means to distribute a sealing solution on the capsules and a computerized control unit to coordinate the members of the apparatus to perform said method. According to the invention, the apparatus also includes:

- two rigid supports movable in steps, each provided with seats designed to contain with minimum clearance the capsules to be sealed, the seats of the second support being in a much larger number than the seats of the first

support;

- for each movable support, respective means for stepped feed;
- means to transfer the capsules from the first to the second movable support; and
- 5 – means to unload the sealed capsules from the second movable support.

In a preferred embodiment of the invention, said movable supports are in the form of circular platforms with vertical axis revolving around their own axis and of a depth similar to the depth of the capsules to be sealed. Said seats to contain the capsules of each platform are through apertures produced in the
10 platform and distributed regularly according to coaxial circumferences, each platform resting on a respective fixed table to prevent the capsules from being dropped.

Preferably, the apertures in the first platform are distributed in the same number according to one or more concentric circumferences spaced apart and the
15 apertures of the second platform are distributed in the same number according to a larger number of radially equidistant concentric circumferences.

The sealing means employed in the aforesaid known apparatus include at least an element to distribute a sealing solution in the form of a thin disk with a horizontal axis, the rim of which is partially immersed in a container containing
20 the suitably heated liquid sealing solution. The disk comes into contact subsequently, one at a time, with the capsules raising them slightly from their support and giving them a rotating movement. In this way, the disk transfers a little of the liquid solution from its periphery to the periphery of the rim of the cap of the capsule. The periphery of the disk, in a radial section, is configured with a
25 ridge, so as to come into contact both with the cap and with the body of the capsule. The solution can thus wet both parts of the capsule and, penetrating between them through capillarity, seal them together. Nonetheless, each capsule is slowed in rotation by friction against the edge of the seat in which it is located and it is therefore possible for its rotation to be irregular so that not all of the rim of

the cap is wetted with the sealing liquid.

According to the present invention, to distribute the sealing liquid on the rim of the capsules, a similar device is used wherein, however, to overcome this drawback, an oscillating element is provided at the level of the distributor disk of the sealing solution, comprising a motorized pressure roller that rotates together with the disk in the same direction as it and at the same peripheral speed, and which rests on the capsule to be sealed on the opposed side of the distributor disk. In this way the capsule – guided inside its seat – remains held between the distributor disk and the pressure roller, both rotating concordantly, ensuring uniform rotation of the capsule. Preferably, the pressure roller has on its periphery, for each capsule, a pair of gaskets made of rubber or another resilient material, designed – in the manner of two disks placed side by side at a limited distance from each other – to come into contact with the capsule on opposed sides with respect to the rim of the cap of the capsule. These gaskets are both spaced from said rim, so that they do not come into contact with the solution distributed thereon.

To transfer the capsules from the first to the second platform, the platforms – with the respective fixed tables – are partly superimposed horizontally and moved vertically close to each other, one above the other, to allow gravity transfer. In fact, on the fixed table positioned under the upper platform, for each circumference of apertures, a through aperture is provided designed to allow a capsule to be dropped from a seat in the upper platform to a seat in the lower platform, and provided under the lower disk are suction means designed to accelerate and guide this dropping. Moreover, the assembly of the second platform with the relative fixed surface can be moved radially in steps with respect to the first platform, to present in succession a different circular row of apertures to receive the capsules.

Preferably, the capsules to be sealed are disposed in the first platform in a horizontal position, with the axis of the capsule disposed radially and, for capsules

with an elongated form, in the second platform in a vertical position, with means provided to vary the position of the capsules during their transfer from the first to the second platform. In this way, as the transverse section of the capsules is generally much smaller than the axial section, a much larger number of capsules
5 can be distributed on the second platform than those that can be contained in the first platform.

Said means to vary the position comprise, in each through aperture of the fixed table adjacent to the first platform, two projections to support the capsule to be transferred, said projections being disposed inside the aperture at the level of
10 the opposed ends of the capsule. One of these projections, is movable by means of a controlled actuator to free the through aperture and allow one end of the capsule to drop, so that it turns from a horizontal position to a vertical position while being drawn by said suction means inside a seat of the second disk.

The microprocessor control unit of the apparatus is designed to control, in
15 a synchronized manner and in pre-established times, stepped rotation of the two platforms and relative translation of the second platform with respect to the first, activation of the means to transfer the capsules from the first to the second platform and in general synchronized operation of the means to feed the capsules and distribute the sealing solution.

20 The invention shall now be better understood by following the description and accompanying drawing, which shows a non-limiting example of the invention, in particular an apparatus according to the invention for sealing capsules of elongated form containing a pharmaceutical. In the drawing:

Figure 1 shows a plan view of an apparatus for sealing capsules according
25 to the invention;

Figure 2 shows a partially enlarged sectional side view according to II-II in Figure 1;

Figure 3 shows the detail III in Figure 1 enlarged;

Figures 4 and 4A each show a sectional view according to IV-IV in Figure

3, in two different positions of the members represented;

Figure 5 shows a partial plan and sectional view according to V-V in Figure 4;

Figure 6 shows the detail VI in Figure 1 enlarged;

5 Figures 7 and 8 respectively show sectional views according to VII-VII and VIII-VIII in Figure 6;

Figure 9 shows a sectional view according to IX-IX in Figure 8; and

Figure 10 shows the detail X in Figure 8 enlarged.

The capsules 7 (Figure 10) to be sealed have an elongated form with a
10 circular cross section and are formed of a hollow body 7A and cap 7B, the cap being inserted over the body.

With reference to Figures 1 and 2, the apparatus comprises a pair of disk-shaped assemblies 1, 3 with vertical axis, each of which comprising an upper circular platform A1, A3 revolving around a respective vertical shaft Z1, Z3; in
15 said platform respective pluralities of through apertures B1, B3 are produced, each designed to receive a capsule 7 to be sealed. Each platform is positioned above, at a slight distance (i.e. 1 mm), a respective fixed table D1, D3, and is provided with a feed device comprising an arm E1, E3 revolving around the respective shaft Z1, Z3 and fitted at the end with a pneumatic jack F1 F3 designed to engage/disengage
20 a pin G1, G3 in successive notches H1, H3 produced on the periphery of the platform, to draw it in rotation. The notches H1, H3 are distributed uniformly on the periphery of each platform A1, A3. For each platform A1, A3 a respective feed device, not shown in the drawing, periodically makes each arm E1, E3 rotate by an angle equal to the angular pitch of the notches with a pre-established dwell time
25 between one rotation and the next, and operation of the jack F1, F3 is coordinated with this oscillating movement so as to cause intermittent rotation of each platform A1, A3 in the direction of the arrows L1, L3. Between one angular feed movement and the next, each platform A1, A3 is held in the position reached by means of a respective elastic or controlled stop device, not shown in the drawing,

which engages in the notches H1, H3.

The apertures B1 are distributed uniformly on the platform A1 in an equal number, with the same angular pitch as the notches H1, according to two concentric circumferences V1, W1 spaced from each other by a distance (d), the
5 apertures of the two circumferences being aligned with one another in twos in a radial direction.

By means of a loading hopper and a positioning device, known per se, and moreover by means of a pair of ducts 9 terminating above the platform A1 at the level of a feed station C, the capsules are disposed in the apertures B1 of the disk
10 A1 in a horizontal position, resting on the upper surface of the fixed table D1, with the axis positioned radially to the platform. The form of the apertures B1 is mainly rectangular, to contain with minimum clearance the capsule disposed horizontally, and has at the center two opposed recesses C (Figure 3) at the level of the rim of the cap 7B of the capsule, so that the edge of the aperture does not
15 come into contact with the liquid solution distributed along the rim of the cap of the capsule.

Through transfer means, which shall be described hereunder, the capsules are then transferred from the platform A1 into the apertures B3 of the platform A3. The apertures B3 are circular in shape and designed to hold the capsule in the
20 vertical position with minimum clearance, with the cap 7B positioned facing downwards. This arrangement makes it possible to produce in the platform A3 a number of apertures five times the number produced in the platform A1, said platforms having more or less equal overall dimensions. The apertures B3 are distributed uniformly on the platform A3, with the same angular pitch as the
25 notches H3, according to a number of concentric circumferences (ten in the present example) radially distanced from one another by a constant pitch (p) equal to a fifth of the radial distance (d) of the apertures B1 of the platform A1 (see also Figure 2). The apertures B3 of the various circumferences are aligned with one another in a radial direction and, for the reason to be clarified hereunder, are

considered as divided radially into two groups of five, an outer group V3 and an inner group W3.

Positioned beside the first platform A1, downstream of the station 9 in the direction L1 of rotation, fitted to the base of the apparatus is a device to distribute the liquid solution 5 (see also Figures 5 to 10), comprised, for each row of apertures V1, W1 of the first platform A1, of a thin disk 11, 13, both partially immersed in a container 12 with the liquid solution. The rim of the disks 11, 13 is of the same thickness as the portion of the capsule to be wetted and, through respective through apertures 15, 17 produced in the fixed table D1 at the level of each row V1, W1 of apertures B1, with stepped rotation of the platform A1 comes into contact successively – raising them slightly – with the capsules 7 disposed inside the apertures B1. The edge of the disks has a ridge similar to the one between the cap 7B and the body 7A of the capsule, so that it comes into contact with both parts of the capsule. Each disk 11, 13 is keyed onto a common shaft 14 made to rotate by an electric motor 16, so that the capsule 7 with which it comes into contact is made to rotate, wetting it with the solution collected from the container 12 along the entire circular periphery of the capsule.

The distributor device 5 also comprises an oscillating element 19 that carries, projecting radially above the platform A1, a pressure roller 21 rotating together with the disks 11, 13 in the same direction L4. The roller 21 has on the periphery, at the level of each row V1, W1 of aperture B1, a pair of rubber gaskets 23, 25 designed to come into contact with the capsules contained in the apertures B1 on opposed sides and spaced with respect to the rim of the cap 7B of the capsules. The roller 21 is made to rotate by the same motor 16 by means of a gear transmission 27 and toothed belts, so that the peripheral speed of the gaskets 23, 25 is equal to the speed of the disks 11, 13. In this way by means of said gaskets the roller 21 rests on the capsules 7, which are slightly raised by the disks 11, 13 and contributes towards keeping them in rotation to distribute the solution uniformly on the rim of the cap 7B of said capsules.

The platform A3 is placed partially under the platform A1 (see also Figures 2 to 4) and, by means of a translation device 29, can be translated radially according to the arrow M with respect to the platform A3. The shaft Z3, which supports the platform A3 and the fixed table D3, is fitted to a plate 31 sliding in the direction M with respect to the base of the apparatus by means of a pair of guides 32, only one of which is shown in Figure 2. Therefore, the platform A3 can be translated radially towards the platform A1 from the position in Figure 2 wherein, in a transfer station T, the first aperture B3 on the left (looking at Figure 2) of each group V3, W3 is aligned vertically under a corresponding aperture 45 of a pair of apertures produced in the fixed table D1, to a second position wherein the second aperture of said groups V3, W3 of apertures is vertically aligned under said apertures 45. Between one translation and the next the platform A1 is rotated by one step, so that another pair of apertures B1 containing capsules are positioned above the apertures 45. The movement to translate the platform A3 and rotate the platform A1 is repeated, until the capsules are transferred to all the apertures B3 of a radial row of said apertures. The direction of translation is then inverted and the method continues with transfer of the capsules in an adjacent row of apertures 3, as so forth.

For this purpose, the translation device 29 comprises four pneumatic jacks 33 to 39 (Figure 2) aligned in series in the direction M and interposed between an upright 41 fixed to the base of the apparatus and an upright 43 fixed to the plate 31. Each jack allows travel equal to the pitch (p) of the circumferences V3, W3, the rod of the first jack 33 being fixed to the body of the second jack 35 and so forth. In this way, by operating the jacks 33 to 39 one at a time, it is possible to radially translate the lower platform A3 with respect to the upper platform A1, moving it closer or farther away by the desired number of pitches (p) in the horizontal direction M.

Above the table D1, at the level of the through apertures 45, a groove 47 is produced wherein a plate 49 runs (see also Figures 5 and 11). The edge of this

plate has a pair of teeth 51, which normally project (Figure 4A) respectively in each through aperture 45 under the end of the cap 7B of the capsules contained in the apertures B1, to support them. Two fixed plates 57 are also fitted in the groove 47, each to project in a respective through aperture 45 under the end of the base 7A of said capsules. By means of a pneumatic actuator 53 and an operating lever 55, the teeth 51 can be withdrawn from the through apertures 45, as shown in Figure 4. In this way the capsules 7 which with rotation of the platform A1 are positioned above the through holes 45, are temporarily supported at the ends by the teeth 51 and the plates 57. By operating the actuator 53, the teeth 51 are withdrawn from the through holes 45 (see Figure 4) and the caps 7B of the capsules B1 can be released, so that both the capsules, tilted from the horizontal position to a position with the cap facing downwards, are dropped from the through apertures into the underlying seats B3 of the platform A3. To facilitate and accelerate dropping, the fixed table D3 has through holes 46 at the level – horizontally – of the radial row of apertures B3 underneath the through apertures 45, and moreover respective suction nozzles 59 connected to a suction source are positioned under the fixed table D3, aligned vertically with the through apertures 45 of the table D1.

The apparatus is provided with a microprocessor control unit designed to control in a synchronized way stepped rotation and relative translation of the platforms A1, A3, activation of the actuator 53 to overturn the capsules, and general synchronized operation of the feeding and unloading means.

Therefore, in the operation of the apparatus described, from the feeding hopper (not shown in the drawing) by means of the nozzles 9 (Figure 1), the capsules are fed in twos into respective apertures B1 of the circular alignments V1 and W1 of the platform A1. With stepped feed of the platform A1, the capsules are wetted with sealing solution at the level of the rim of the respective cap 7B by means of the distributor device 5 and remain on the platform A1 until reaching the transfer station T. From this station the capsules, through the apertures 45 of the

fixed table D1, are dropped in pairs overturning from a horizontal position to a vertical position inside the apertures B3 of the platform A3 which, with stepped translation of the platform A3 and as described hereinbefore, were previously positioned under the apertures 45. Finally, after a certain number of angular steps
5 of the platform A3, the capsules deposited thereon are dropped by gravity through an aperture 61 of the fixed table D3, onto an unloading station S of the capsules coming from the apparatus. The stepped rotation speed of the platforms A1, A3 is such that the total time the capsules 7 remain on the apparatus, after being wetted with the sealing solution until unloading from the station S, is sufficient to dry the
10 seal.

It is understood that the drawing only shows an example provided purely as a practical embodiment of the invention, as the invention may vary in forms and arrangements without however departing from the scope of the concept forming said invention. Any reference numbers in the appended claims are
15 provided to facilitate reading the claims with reference to the description, and do not limit the scope of protection represented by the claims.